HGM data review – Proposed Seven Hills Mine

Seven Hills Baseline

1.) Functional Capacity Indices should be weighted by area and cover types should be segregated into partial wetland assessment areas.

As the HGM is a measure of functional quality over a representative area, giving it equal weight to each plot separate of the relative acreage it represents of the site, under-represents the condition of the forested areas onsite. Since the WKY Guidebook uses a mature forest as the reference standard condition, areas of herbaceous and shrub cover will show decreases in vegetative subindices. According to the WKY Guidebook, areas of varying cover types should be segregated into separate partial wetland assessment areas, so that the effects of the earlier successional vegetative community types can be evaluated apart from the more mature forested communities. By identifying the areas and associated acreages the plots represent, a detailed discussion of avoidance and minimization efforts can be applied, where practicable, and then calculated directly for the wetland resource impacted.

In 2006, Eco-tech provided areas and associated acreages that each of the sample plots represented. They also provided several estimate plot values for area, where scores would be different based on certain parameters such as proximity to streams.

2.) Direct comparison of 2006 and 2017 data

The relocation of plots prevented a direct comparison of all the 2006 and 2017 data. While we understand the need to represent the conditions and various cover types within the sites, adding plots to allow the direct comparison of all sites is preferred.

Additionally, there were changes in some individual variables which were not fully explained (Vslope, Vstore, Vwtslope, Vohor, Vahor) that little or no change would be expected given that site conditions were relatively unchanged with no anthropogenic changes.

3.) Presentation and comparison of plots as a FCI means

Eco-tech states that "overall wetland functions of the Pigeon Creek floodplain appear to have changed little over the last 11 years based on the comparative HGM assessment of the proposed mine site. No recent anthropogenic impacts of natural disturbances were noted with the wetland assessment area and the site remains in a similar condition to 2006."

Variations in the individual functional scores and functional measures do not support this statement. For example, plot 4 appeared to have successional changes at both the functional level and the variable measures which include an increase in tree density, tree basal area, and snags, understory biomass reduction (no sub-index score change), and an increase in coarse woody debris. These measures indicate some maturation and successional development, but is skewed by reductions in other functions on every plot for export carbon, maintain characteristic hydrology, cycle nutrients, and remove and sequester elements and compounds. However, portions of those functions were based on reductions in variables that we would not expect to change on a site that has little disturbance and no anthropogenic impacts. See specific comments below on each variable.

4.) Representative Assessment of the Export Carbon function ($V_{surfcon}$)

Eco-tech indicated that they changed their interpretation of this function for the 2017 assessment. As stated in the WKY Guidebook, Export of Carbon is "the capacity of the wetland to export the dissolved and particulate organic carbon produced in the riverine wetland. Mechanism include leaching of litter, flushing, displacement, and erosion." The implicit process in Organic Carbon Export is that the site is hydrologically connected to areas downstream. Although Eco-Tech has interpreted the surface connection variable very literally as an "altered channel" they did not consider the variable in the greater context of the site and other functions performed. The Temporary Storage of Surface Water and Particulate Retention functions both require surface water from the channel (represented by Vfreq) to enter the floodplain in order to be stored and drop sediment. This very connection, acknowledged by Eco-Tech as taking place at reference standard levels (FCI = 1.0 for both functions in all cover types) seems to contradict the assertion that the carbon export function does not take place. We question the scoring this function as zero, indicating the wetland is not performing organic carbon export in any capacity.

Based on a review of their data, the Export Carbon function was scored as zero based solely on their application of $V_{surfcon}$. The surface connection variable "represents the internal network of shallow surface water channels that usually connect the riverine wetland to the stream channel on low gradient, riverine floodplains. Typically, these channels intersect the river channel through low spots in the natural levee. When water levels are below channel full, these channels serve as the route for surface water, and the dissolved and particulate organic matter it carries, as it moves from the floodplain to the stream channel. This same network of channels routes overbank floodwater to riverine wetlands during the early stages of overbank flooding." By Eco-tech scoring the percent altered at 100 they are making the conclusion that the alteration of the system is preventing it from any surface connections and means there is no linear connection through tributaries or to Pigeon Creek itself. EPA recognizes Pigeon Creek has been channelized in the past and small tributaries to Pigeon Creek have down-cut to the point where it may require larger flow events to cause water to spill over the banks. However, it does not take an overbank event from Pigeon Creek to "back" water up onto the floodplain via the tributary/drainage channels. If those tributary channels cannot outlet the water due to higher flows in Pigeon Creek, the surface water draining to those channels will back up onto the floodplain. Once Pigeon Creek flows diminish, then the flows from the tributaries will drain into Pigeon Creek along with dissolved and particulate organic matter which will be utilized downstream.

The intent of the $V_{surfcon}$ variable was to represent the necessity of surface water connections between the floodplain and the stream channel to transport organic material downstream to support aquatic organisms. The stressor this variable was intended to capture were levees which prevented floodplains from being inundated by larger stream flows. Although the exchange of surface water between Pigeon Creek and the adjacent riverine wetland/floodplain may be diminished, EPA contends it is not absent. Therefore, the variable scoring should be revised along with the functional capacity index to reflect a more realistic estimate of stream alterations that limit function.

(Noted that the Vohor is reduced in some locations plot 1, plot 3, plot 4, plot 6 where did it go? My assumption based on ecological processes is either that it was decomposed more to be part of Vahor (but there are no Vahor no a horizons documented) or exported downstream because it is actually connected which is not reflected in the functional assessment of Vsurfcon.)

5.) Units of measurements

A careful examination of the field data that comprise the basis for the variable subindices indicated that in some instances appropriate plot size may not have been utilized. For instance, some variables are assessed using a 0.04 ha plot, some using a 0.004 ha plot, and others using a one square meter plot. Appropriate conversion factors may not have been used in all calculations which would affect the final variable field estimate and the associated subindex. The lack of documented assumptions and field conditions affecting variable measurement, along with incomplete field data sheets, made it difficult to decipher how the subindex scores were calculated. Field measurements and the calculation of subindex values be reviewed and revised as appropriate.

6.) Understanding changes in sub index measurement and scores. Below are listed the subindices which need clarification. The subindices are listed in the order described in the Appendix B for ease of review.

Vtract – Provide the boundaries of tract on a map with an aerial.

V_{slope} – The slope calculated changed from 0.003 in 2006 to 0.02 in 2017. Please explain the change in slope value.

V_{rough} – This is a measure of roughness. In plot 4 and 8, there was no change to macrotopography (V_{macro}), woody debris (Vwd) increased, and log biomass (Vlog) increased but overall roughness decreased. These other subindices indicate and increase in obstructions and would be correspondingly detected in this measure. Conversely in plot 2, there was no change in roughness despite a decrease in Vwd and Vlog. Recommend a review this measure and revision as appropriate.

$V_{soilint}$ – Eco-tech noted that there are no altered soils however, there were changes to other soil sub-indices to include measures of the O horizons and A horizons. See notes on each below.

$V_{wtslope}$ – It is not clear why the water table slope changed from 2006 to 2017. Again without a methodology it is difficult to understand the manner this subindex was calculated. However, it appears from a review of the data that Pigeon creek was treated as a ditch and not a dredged stream when calculating the watertable slope. Recommend the historic bottom elevation of Pigeon Creek used and the depth of alteration would be the difference between the old and new channel.

V_{store} – How did the floodplain storage change from 2006 to 2017? While the functional subindex was 1.0, it seems odd that there were changes in the ratio of floodplain to channel width.

$V_{surfcon}$ – See note comments on Export Carbon above. This subindex score needs to be revised.

V_{ten} – Explain the increase of tree density in plot 3, 4, 5, 6, and 9 and how it may be reflected in another metric such as a change in understory vegetation biomass (which could reflect unstory sucession into the tree level) or Vsnag (which may reflect the death of trees from 2011). Also explain the reduction in tree density in plot 2 and how it relates to changes conversely in other metrics.

V_{tba} –Explain the changes in tree basal area. For example in plot 3, there was an increase in tree density by 174 stems/ha but the tree basal area only increased slightly by 0.03 m^2/ha. Also review the reduction in basal area on plot 6, when the tree density increased by 125 stems/ha.

V_{ssd} – This metric was incorrectly calculated. Based on the field datasheets it appears Eco-tech used the total stems counted in two plots not the average of those counts. This change increases the stem count and affects the functional subindex. For example, plot 1 this resulted in a functional measure of 850 instead of 725 stems per hectare and resulted in a lower functional subindex score of 0.50 instead of 0.55. The data for measures should be reviewed and recalculated as appropriate.

V_{ahor} - Eco-tech did not document any "A horizons" during the 2017 data collection. The Web Soil Survey for the site indicates all soil series mapped on the site developed A-horizons. The procedure outlined in the WKY Guidebook to verify the presence of an A-horizon requires, the soil horizon begin just below the O-horizon or at the surface and is considered an "A" horizon, if it is at least 7.6 cm (3in) thick and has a munsell color value less than or equal to 4." As Eco-Tech noted in their narrative and is reflected in the soil integrity subindex (Vsoilint), the soils on site have not been altered. Therefore, EPA would anticipate that the soils structure would not change. Explain the changes in the "A horizon" subindex.

V_{wd}- It appears there were errors in calculations within the datasheets. Specifically, on size class 3 tons per acre on the data sheet which appear to be corrected on the final spread sheet. These calculations should be reviewed and corrected as needed.

In summary, to the extent possible, field measurements, conversions to subindex values, and functional capacity indices should be re-checked. Assumptions or interpretations of instructions or explanations in the WKY Guidebook should be documented. The HGM Approach was designed to be an open process in which all inputs to the models and accompanying assumptions or caveats were fully disclosed.

Potential Mitigation Site Baselines

From a cursory review of the sites, the sites selected do appear to be appropriate landscape position; also soil water features are indicative of riverine wetlands.

Based on their single HGM plots provided and stressors on the proposed sites, the current condition of the sites is not good. This is reflected in the low variable values for live and dead vegetation, and soil horizons are likely impacted due to farming. Further, functional improvements limited by small tract size and landscape connection to other natural or restored areas.

To target effective mitigative goals and design, the stressors in the watershed include agriculture, channelization and mining on the site must be considered. For example, agriculture will remove native plant communities and likely affect soil nutrients and perhaps soil water balances which could be addressed in mitigation design. Channelization of streams affects flooding and subsurface water and may limit functional improvements if stream improvements and connectedness are not incorporated into the mitigation design. Mining could change subsurface flows of shallow groundwater as well as slopes and soil profiles. According to the Web Soil Survey, most if not all the potential mitigation sites have soils which formed under frequent flooding and shallow groundwater (high water table) conditions. If these areas are to be restored, that hydrologic regime should also be re-established. However, it is problematic to consider this appropriate given the small size of each potential mitigation site and the fragmented nature of the sites on the landscape are problematic.

On page 2 of the Eco-Tech memo accompanying the mitigation site baselines, they state that mitigation sites would receive higher functional capacities if they had macrotopographic features, woody debris, tree snags, larger trees, fewer saplings, and plant species composition resembling the reference standard sites. From a Guidebook standpoint it is true that FCIs would be higher if these items could be placed onsite, but it does not address the underlying hydrologic and soil processes that if not are not adequately replaced, the site(s) will not perform appropriately.

As detailed above, we raised several question on the application of the method and those points should be reviewed in relation to the baseline score and the functional improvement anticipated. Below our concerns on the information submitted.

1.) Difficult to discuss appropriateness and feasibility of achieving the anticipated functional changes without any details on planned mitigation actions. Additionally, these results should be reviewed for the same issues described in the baseline data from the Seven Hills mine site. Further we recommend that Peabody/Eco-tech provide general descriptions and any anticipated issues with regard to each site similar to the brief write ups done in 2006. For Squaw Creek specifically, that information should addresses Eco-tech's 2006 concerns on developing that site into mitigation which included but not limited to offsite flooding.

2.) Limited mitigation in Pigeon Creek watershed, i.e., same watershed as where the impacts would occur. We note that only two of the proposed mitigation sites are located within the Highland-Pigeon Creek watershed. We continue to offer any assistance in identifying and evaluating appropriate mitigation sites located within the same watershed as the impact site, where mitigation actions are most likely to successfully replace lost functions and services.

3.) Limited connectivity of mitigation sites to other resources. Several of the sites are agricultural sites and are not connected to larger tracts of wetland. Since they are still surrounded by active farming, there may be limits on the functions possible to restore.